U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-270 033

Caddo Lake, Caddo Parish, Louisiana and Marion and Harrison Counties, Texas

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

Mar 77

PB 270 033

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON
and
ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

N.T.I.S. 000-000

Report
on
Caddo Lake
Caddo Parish, Louisiana
Marion and Harrison Counties, Texas
EPA Region VI
Working Paper No. 637

With the cooperation of the
Louisiana Wild Life and Fisheries Commission
and the
Louisiana National Guard
March, 1977

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.	2. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE: Report on Caddo Lake, Caddo Parish, Louisiana and Marion and Harrison Counties, Texas	5. REPORT DATE: Prepared March 1977
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S): Anonymous (National Eutrophication Survey Staff)	8. PERFORMING ORGANIZATION REPORT NO: Working Paper No. 637
9. PERFORMING ORGANIZATION NAME AND ADDRESS: National Eutrophication Survey U.S. Environmental Protection Agency P.O. Box 15027 Las Vegas, NV 89114	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS: Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460	13. TYPE OF REPORT AND PERIOD COVERED: Final - 1974 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES: Prepared in cooperation with the U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Eutrophication Survey Branch, Corvallis, OR 97330

16. ABSTRACT:

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

18. DISTRIBUTION STATEMENT: Release unlimited	19. SECURITY CLASS (This Report)	21. NO. OF PAGES: 57
	20. SECURITY CLASS (This Page)	22. PRICE: PC A04 / MF A01

EPA Form 2220-1 (9-73)

REPORT ON CADDO LAKE

CADDO PARISH, LOUISIANA

MARION AND HARRISON COUNTIES, TEXAS

EPA REGION VI

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 637

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

March 1977

CONTENTS

	Page
Foreword	ii
List of Louisiana Study Lakes	iv
Lake Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	4
III. Lake Water Quality Summary	6
IV. Nutrient Loadings	14
V. Literature Reviewed	20
VI. Appendices	21

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control and to the Texas Water Quality Board for professional involvement, to the Louisiana and Texas National Guards for conducting the tributary sampling phase of the Survey, and to those Louisiana and Texas wastewater treatment plant operators who provided effluent samples and flow data.

Robert A. Lafleur, Chief; J. Dale Givens, Assistant Chief; Lewis R. Still, Biologist; Louis Johnson, Biologist; Lee Caubarreaux, Biologist; Darrell Reed, Engineer; Dempsey Alford, Biologist; and Elwood Goodwin, Water Quality Control Technician, all of the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control; and Hugh C. Yantis, Jr., Executive Director of the Texas Water Quality Board; John B. Latchford, Jr., Director; and the staff of the Texas Water Quality Board Field Operations Division reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

Major General O'Neil Dalgle, Jr., the Adjutant General of Louisiana, and Project Officer Colonel Lawrence P. Dupre, who directed the volunteer efforts of the Louisiana National Guardsmen; and Major General Thomas Bishop, the Adjutant General of Texas, and Project Officer William L. Seals, who directed the volunteer efforts of the Texas National Guardsmen are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF LOUISIANA

LAKE NAME	PARISH
Anacoco Lake	Vernon
Lake Bistineau	Bienville, Webster
Black Bayou	Caddo
Black Lake	Natchitoches and Red River
Bruin Lake	Tensas
Bundick Lake	Beauregard
Caddo Lake	Caddo (Menon and Harrison in Texas)
Cocodrie Lake	Concordia
Cocodrie Lake (Lower)	Rapides
Concordia Lake	Concordia
Cotile Lake	Rapider
Cross Lake	Caddo
D'Arbonne Lake	Union
False River Lake	Pointe Coupee
Indian Creek Reservoir	Rapides
Saline Lake	LaSalle
Turkey Creek Lake	Franklin
Lake Vernon	Vernon
Lake Verret	Assumption

CADDO LAKE

REPORT ON CADDO LAKE, LOUISIANA
STORET NO. 4807

I. CONCLUSIONS

A. Trophic Condition:*

Survey data indicate that Caddo Lake is eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses of each lake.

Secchi disc visibility in this humic lake was poor and potential for primary production, as measured by algal assay control yields was moderate to high. Chlorophyll a levels ranged from 2.4 µg/l to 95.0 µg/l, with a mean of 21.3 µg/l. Of the 19 Louisiana lakes sampled in 1974, 12 had higher total phosphorus levels, 17 had higher inorganic nitrogen, and 14 had higher orthophosphorus values than Caddo Lake.

Survey limnologists reported emergent vegetation along 80% of the shoreline and an oily surface scum on the lake during all sampling occasions.

B. Rate-Limiting Nutrient:

Algal assay results for the spring sampling season suggested near colimitation in Caddo Lake by phosphorus and nitrogen. In the autumn assay, growth increases accompanied

*See Appendix E.

the addition of phosphorus to the Stations 01 to 03 sample, but in the Stations 04 to 06 sample, growth response was achieved with the addition of nitrogen. Mean inorganic nitrogen to orthophosphorus (N/P) ratios in the lake were 7/1 and less than 6/1, respectively, during March and November, suggesting nitrogen limitation and 14/1 during May, suggesting near-colimitation by the two.

C. Nutrient Controllability:

1. Point sources -

During the sampling year, the mean annual phosphorus load from point sources was estimated to be approximately 3.5% of the total load reaching Caddo Lake. The city of Jefferson contributed 3.0% of that load.

The phosphorus loading of 0.73 g $P/m^2/yr$ for Caddo Lake is less than the "eutrophic" load proposed by Vollenweider (1975) for lakes with such volume and detention time. However, loading calculations yield an apparent net export of phosphorus and nitrogen from the lake. This could be due to an underestimation of nutrient loadings from the six ungaged tributaries entering Caddo Lake (see Section IV-E) or to the lack of nutrient load estimations for the Longhorn Ordnance Plant or other undetected and unmeasured point sources. Any addition to the existing phosphorus loading of this lake should be carefully evaluated until a complete nutrient budget for the lake can be determined.

Nonpoint sources -

The phosphorus load from nonpoint sources was 96.5% of the total reaching the lake during the sampling year. Cypress Bayou contributed 74.7%, Monterey Lake Outlet contributed 10.5%, and the ungaged tributaries and immediate drainage were estimated to have contributed 5.0% of the nonpoint source phosphorus load.

In general, few lakes are nitrogen limited as a result of low nitrogen. Rather, excessive phosphorus levels shift limitations to nitrogen or other factors. Regardless of the primary nutrient limitation suggested by either algal assay or nutrient ratios, the most feasible approach to nutrient control, if desirable, is through available phosphorus control technology and subsequent establishment of phosphorus limitation within the water body.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake surface area and mean depth was provided by the State of Louisiana, maximum depth was estimated on the basis of Survey data; tributary flow data were provided by the Louisiana and Texas District Offices of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 132.09 km^2.
2. Mean depth: 1.0 meters.
3. Maximum depth: 3.0 meters.
4. Volume: 231.896 x 106 m^3.
5. Mean hydraulic retention time: 42 days.

B. Tributary and Outlet:
(See Appendix B for flow data)

1. Tributaries -

Name	Drainage area(km²)	Mean flow (m³/sec)
C-1 Harrison Bayou	112.9	0.93
D-1 Kitchen Creek	88.8	0.73
J-1 Cypress Bayou	5,542.9	46.05
L-1 Monterey Lake Outlet	909.1	7.48
Minor tributaries and immediate drainage -	321.1	3.73
Totals	6,974.5	58.92

2. Outlet - A-1 Willow Pass Creek (Twelvemile Bayou) 7,107.0 64.20

C. Precipitation:

1. Year of sampling: 156.1 cm.
2. Mean annual: 173.7 cm.

III. LAKE WATER QUALITY SUMMARY

Caddo Lake was sampled four times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from six stations on the lake and from one or more depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll *a* analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 1.5 meters at Stations 01, 04, 05, and 06, and 1.8 meters at Stations 02 and 03. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll *a* determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

[illegible]

[illegible]

[illegible]

[illegible]						
[illegible]						
[illegible]						
[illegible]

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
03/23/74	1. Melosira	4,960
	2. Chlamydomonas	1,114
	3. Flagellates	861
	4. Raphidiopsis	709
	5. Nitzschia	607
	Other genera	3,491
	Total	11,744
05/31/74	1. Lyngbya	10,979
	2. Melosira	2,627
	3. Dactylococcopsis	1,957
	4. Nitzschia	1,957
	5. Microcystis	1,141
	Other genera	7,255
	Total	30,816
06/03/74	1. Lyngbya	18,932
	2. Melosira	5,177
	3. Pennate diatom	1,923
	4. Microcystis	1,331
	5. Merismopedia	1,036
	Other genera	7,543
	Total	35,941

F. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (ug/l)
03/24/74	01	4.9
	02	8.7
	03	5.4
	04	10.1
	05	10.9
	06	11.0
05/21/74	01	28.1
	02	28.1
	03	28.1
	04	95.0
	05	16.9
	06	26.3
08/26/74	01	15.8
	02	20.5
	03	11.3
	04	25.0
	05	27.6
	06	22.4
11/11/74	01	2.4
	02	2.5
	03	7.1
	04	11.9
	05	6.0
	06	6.0

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. 03/23/74 - Stations 01-05

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.017	0.069	1.0
0.05 P	0.067	0.069	1.8
0.05 P + 1.0 N	0.067	1.069	16.6
1.00 N	0.017	1.069	1.4

b. 11/11/74 - Stations 01-03

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.010	M*	0.6
0.05 P	0.060	M	2.3
0.05 P + 1.0 N	0.060	M	14.2
1.00 N	0.010	M	0.6

c. 11/11/74 - Stations 04-06

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.016	0.067	2.2
0.05 P	0.066	0.067	2.4
0.05 P + 1.0 N	0.066	1.067	17.0
1.00 N	0.016	1.067	3.6

*Missing.

D. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potentials for primary production were moderate to high in Caddo Lake at the times of sampling. In the spring assay, spikes with either phosphorus or nitrogen alone produced slight increases in assay yield, suggesting near colimitation by the two nutrients. Maximum yield was achieved with the simultaneous addition of both nutrients.

In the autumn assay, the control yield of the assay for Stations 01 to 03 was much lower than that for Stations 04 to 06. This is possibly attributable to the proximity of Stations 04 to 06 to the Mooringsport sewage treatment plant outfall. The assay for Stations 01 to 03 showed a growth response to the addition of phosphorus, suggesting phosphorus limitation, while the Stations 04 to 06 assay showed response to the addition of nitrogen. Again, simultaneous additions of both phosphorus and nitrogen resulted in maximum assay yields.

The mean N/P ratios in the lake data were 7/1 and less than 6/1 for March and November suggesting nitrogen limitation. The N/P ratio of 14/1 during May sampling suggests borderline phosphorus limitation (an N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

It should be noted that significant chemical changes took place in Louisiana lake samples between collection and assay analysis. The assay data should be considered in this context and until such differences are resolved, used with caution for any prediction of actual lake conditions. Such chemical changes are likely to alter the control yield as well as modifying the N/P ratio.

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Louisiana and Texas National Guards collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of February when two samples were collected. Sampling was begun in June 1974, and was completed in April 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Louisiana and Texas District Offices of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in $kg/km^2/yr$, in Harrison Bayou, Kitchen Creek, and Monterey Lake outlet at Stations C-1, D-1, and L-1, and multiplying the means by the ZZ area in km^2.

The operators of the Jefferson and Keoringsport wastewater treatment plants provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

Name	Population Served[a]	Treatment[a]	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Jefferson	2,000	Stabilization pond	2.116	Black Cypress Bayou
Mooringsport	850	Trickling filter	0.246	Caddo Lake

2. Known industrial -

Name	Product	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Longhorn Ordnance Plant	Ammunition	Trickling Filter	Unknown	Caddo Lake

[a]Sewage treatment plant questionnaires.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
C-1 Harrison Bayou	2,655	2.7
D-1 Kitchen Creek	860	0.9
J-1 Cypress Bayou	72,560	74.7
L-1 Monterey Lake Outlet	10,200	10.5
b. Minor tributaries and immediate drainage (nonpoint load) -	4,815	5.0
c. Known municipal STP's -		
Jefferson	2,930	3.0
Mooringsport	485	0.5
d. Septic tanks* -	260	0.3
e. Known industrial -		
Longhorn Ordnance Plant	Unknown	---
f. Direct precipitation** -	2,310	2.4
Totals	97,075	100.0

2. Output -

A-1 Willow Pass Creek (Twelvemile Bayou)	103,390

3. Net annual P export*** - 6,315

*Estimate based on 58 lakeside residences, 1 state park, and 130 camps.
**Estimated (see NES Working Paper No. 175).
***Export probably due to unknown sources and/or sampling error.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
C-1 Harrison Bayou	21,710	1.5
D-1 Kitchen Creek	14,310	1.0
J-1 Cypress Bayou	1,052,130	72.6
L-1 Monterey Lake Outlet	147,470	10.2
b. Minor tributaries and immediate drainage (nonpoint load) -	55,230	3.8
c. Known municipal STP's -		
Jefferson	4,880	0.3
Mooringsport	1,500	0.1
d. Septic tanks* -	9,795	1.7
e. Known industrial -		
Longhorn Ordnance Plant	Unknown	---
f. Direct precipitation** -	142,605	9.8
Totals	1,449,630	100.0

2. Outputs -

A-1 Willow Pass Creek (Twelvemile Bayou)	1,775,590

3. Net annual N export*** - 325,960

*Estimate based on 58 lakeside residences, 1 state park, and 130 camps.
**Estimated (see NES Working Paper No. 175).
***Export probably due to unknown sources and/or sampling error.

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Harrison Bayou	24	132
Kitchen Creek	10	161
Cypress Bayou	13	190
Monterey Lake Outlet	11	162

E. Mean Nutrient Concentration in Ungaged Streams:

Tributary	Mean Total P (mg/l)	Mean Total N (mg/l)
B-1 Tete Bayou	0.056	0.943
E-1 Mill Creek	0.038	0.598
F-1 James Bayou	0.044	0.657
G-1 Hunts Creek	0.048	1.050
H-1 Tiger Branch	0.056	0.985
K-1 Saunders Branch	0.062	0.637

Nutrient levels for the above ungaged tributaries are all comparable to those levels in the measured tributaries entering Caddo Lake.

F. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between "eutrophic" and "oligotrophic".

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading ($g/m^2/yr$)
Estimated loading for Caddo Lake	0.73
Vollenweider's "eutrophic" loading	0.74
Vollenweider's "oligotrophic" loading	0.37

V. LITERATURE REVIEWED

Ketelle, Martha J. and Paul D. Uttormark. 1971. Problem Lakes in the United States. U.S. Environmental Protection Agency Project #16010 EHR. University of Wisconsin, Madison, Wisconsin.

Shampine, W. J. 1971. Chemical, Biological, and Physical Data for the Major Lakes and Reservoirs in Louisiana. Louisiana Dept. of Public Works, #5. Baton Rouge, Louisiana.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

VI. APPENDICES

APPENDIX A
CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

Reproduced from best available copy.

APPENDIX B

TRIBUTARY FLOW DATA

[illegible] FLOW INFORMATION FOR LOUISIANA [illegible]

[illegible] LAKE [illegible]

[illegible] MONTHLY FLOWS AND YEARLY FLOWS (CFS)

[illegible]	[illegible]	[illegible]	[illegible] FLOW	TOT	FLOW	DAY	FLOW	DAY	FLOW
[illegible]	6	74	[illegible]	[illegible]	[illegible]				
	7	74	[illegible]	[illegible]	[illegible]				
	8	74	[illegible]	[illegible]	[illegible]				
	9	74	[illegible]	[illegible]	[illegible]				
	10	74	[illegible]	[illegible]	[illegible]				
	11	74	[illegible]	[illegible]	[illegible]				
	12	74	[illegible]	[illegible]	[illegible]				
	1	75	[illegible]	[illegible]	[illegible]				
	2	75	[illegible]	[illegible]	[illegible]	22	[illegible]		
	3	75	[illegible]	[illegible]	[illegible]				
[illegible]	6	74	[illegible]	[illegible]	[illegible]				
	7	74	[illegible]	[illegible]	[illegible]				
	8	74	[illegible]	[illegible]	[illegible]				
	9	74	[illegible]	[illegible]	[illegible]				
	10	74	[illegible]	[illegible]	[illegible]	10	[illegible]		
	11	74	[illegible]	[illegible]	[illegible]				
	12	74	[illegible]	[illegible]	[illegible]				
	1	75	[illegible]	[illegible]	[illegible]				
	2	75	[illegible]	[illegible]	[illegible]	22	[illegible]		
	3	75	[illegible]	[illegible]	[illegible]	22	[illegible]		
	4	75	[illegible]	[illegible]	[illegible]				

APPENDIX C

PHYSICAL AND CHEMICAL DATA

Reproduced from
best available copy.

| | | |

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1974

STATES OF LOUISIANA AND TEXAS

LAKE DATA TO BE USED IN RANKING

LAKE CODE	LAKE NAME	[illegible] TOTAL P	[illegible] TMDL %	[illegible] [illegible]	[illegible] [illegible]	[illegible] [illegible]	[illegible] [illegible]
2201	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2202	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2203	LAKE [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2204	[illegible] [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2205	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2207	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2208	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2209	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2210	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2211	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2212	[illegible] [illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2213	[illegible] [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2214	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2215	[illegible] [illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2216	LAKE [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2217	LAKE [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2218	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2219	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4807	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] OF LAKES WITH <OTHER VALUES> [illegible] OF LAKES WITH <OTHER VALUES>

LAKE CODE	LAKE NAME	[illegible] TOTAL P	[illegible] [illegible] P	[illegible] [illegible]	[illegible] CALCIUM	[illegible] [illegible]	[illegible] [illegible] [illegible] P
2001	[illegible] LAKE	47 : 244	63 : 240	47 : 121	66 : 240	63 : 250	94 : 171
2002	[illegible] LAKE	42 : 117	11 : 25	63 : 259	42 : 111	0 : 0	58 : 42
2003	LAKE [illegible]	42 : 42	58 : 65	42 : 111	72 : 131	42 : 71	33 : 43
2004	[illegible] [illegible]	72 : 131	72 : 133	78 : 241	56 : 100	58 : 42	63 : 240
2005	[illegible] LAKE	11 : 29	33 : 42	33 : 42	44 : 80	78 : 241	0 : 0
2007	[illegible] LAKE	29 : 50	0 : 0	11 : 25	11 : 21	100 : 100	17 : 33
2008	[illegible] LAKE	42 : 250	58 : 65	94 : 171	63 : 250	33 : 42	63 : 111
2009	[illegible] LAKE	44 : 0	63 : 240	38 : 71	22 : 42	24 : 25	63 : 240
2010	[illegible] LAKE	56 : 100	63 : 240	29 : 54	6 : 11	72 : 131	42 : 171
2011	[illegible] LAKE	78 : 240	58 : 65	56 : 100	94 : 171	42 : 71	56 : 100
2012	[illegible] [illegible] LAKE	33 : 63	38 : 71	63 : 240	38 : 59	6 : 11	29 : 50
2013	[illegible] [illegible]	42 : 240	38 : 54	58 : 42	38 : 71	24 : 25	44 : 171
2014	[illegible] LAKE	17 : 33	6 : 11	0 : 0	42 : 171	94 : 171	22 : 42
2015	[illegible] [illegible] LAKE	6 : 0	17 : 29	22 : 42	33 : 64	22 : 42	11 : 21
2016	LAKE [illegible]	6 : 11	58 : 65	6 : 11	0 : 0	56 : 100	6 : 11
2017	LAKE [illegible]	100 : 100	44 : 0	100 : 100	100 : 100	29 : 50	100 : 100
2024	[illegible] LAKE	38 : 71	22 : 42	72 : 131	78 : 240	42 : 171	38 : 71
2025	[illegible]	22 : 42	100 : 100	17 : 29	17 : 33	63 : 111	44 : 0
4007	[illegible] LAKE	42 : 171	94 : 171	44 : 0	58 : 42	63 : 240	63 : 240